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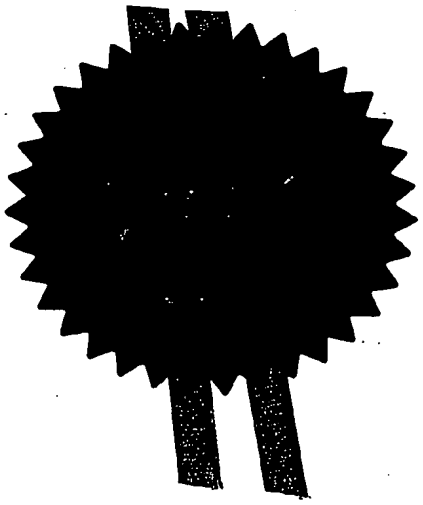

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   William Lyle WARKE
   30 Ballybrakes Road
   Ballymoney, BT53 6LG,
   County Antrim, Northern Ireland, U.K.

   Patents ADP number *(if you know it)* 04007175003

   If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention — TURF CUTTER/DECOMPACTOR

5. Name of your agent *(if you have one)* — ANSONS

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A TURF CUTTER / DECOMPACTOR

The present invention relates to turf cutters/decompactors and in particular to versatile precision turf cutters/decompactors.

Turf cutters have been used by Green-keepers and grounds-staff in the sports-turf sector of the industry for many years, mostly to remove old tired turf for replacement and for stripping healthy turf for relaying. The turf cutter is also quite often used to remove a narrow strip of turf for other purposes such as drainage, which can be re-laid on completion. Landscapers and contractors also find the Turf-cutter machine very useful for removing grass surfaces in preparation for shrub beds and pathways etc. or to be re-laid after construction work has been carried out. Healthy turf which has been cut for laying new grass areas or to replace worn turf obviously needs to be cleanly cut with no ragged edges but it is also vital that it be of a constant thickness to maintain a level finished surface. This is especially true in golf greens, bowling greens, cricket and fine lawns. These types of surfaces are often referred to as 'fine turf.' To enhance recovery of the source area the trend is to cut ever finer or thinner slices of turf. Additionally and certainly in the case of golf courses the areas selected for stripping may be undulating which compounds the problem of thickness consistency. When striping large areas it is customary due to efficiency to cut all the turf first, then roll and remove it. A clear and unrestricted vision of the blade and the previous cut line is imperative in order to avoid overlapping i.e. cutting a portion out of the previous piece. Inability to accurately control this results in an uncut portion being left between. This in turn has to be removed in the interests of maintaining an even surface.

Pedestrian and tractor mounted types of turf-cutters are available. The tractor mounted machines are normally used by specialist contractors for the purpose of stripping larger areas or by turf farms for harvesting. Pedestrian operated machines are more suitable for the purpose described in paragraph one but they fall short of the precision of cut achieved by the more sophisticated and hugely more expensive turf harvesters. Ideally the pedestrian machine would be capable of using a narrow blade for trenching or maximum depth requirements as well as a wide blade for large area stripping and relaying work. Changing blades should be simple for the operator. Precision of cut

should remain consistent and the operators sight line for blade alignment in all widths of cuts should not be impeded.

Turf cutters have an oscillating blade which can be adjusted to the required depth and pulled or pushed through the turf by a ground engaging drum or wheels. The oscillating action enables the turf cutter machine to propel the blade through the ground with the minimum of traction or forward propulsion. Other operations could be performed using this principal, such as drainage and de-compaction but the chassis and drive mechanism on traditional turf cutters do not lend themselves to accommodate the various blades or blade arrangements.

Accordingly, the present invention provides an apparatus for cutting turf, for soil decompacting and for soil drainage comprising a chassis have ground engaging means, an adjustable working arm having a chassis-engaging end movably mounted on the chassis and a tool-engaging end having means for receiving a tool, the apparatus having means for oscillating the tool-engaging end of the adjustable working arm wherein the oscillating means comprises a drive means mounted on the chassis and a single connecting rod mounted intermediate the drive means and the adjustable working arm.

Ideally, the drive means is a camshaft.

Preferably, the connecting rod is movably mounted on the adjustable working arm intermediate its two ends.

Ideally, the chassis-engaging end of the adjustable working arm is pivotally mounted on a housing which is movably mounted on the chassis.

Preferably, the housing is a depth-set housing which is movable along a substantially vertical axis for adjusting the depth of a tool relative to the surface of the ground.

Ideally, the ground engaging means comprises a pair of axles, each axle having a wheel disposed on opposite ends thereof and the chassis, the adjustable working arm and the oscillating means are disposed intermediate the wheels of each axle.

Ideally, a turf cutting knife comprising a turf undercutting blade orientated substantially horizontally in use is mounted on the tool receiving means of the adjustable working arm and the turf

undercutting blade is disposed substantially vertically below an axis of rotation of the ground engaging means.

Preferably, the ground engaging means comprises an aft axle carrying wheel means thereon and being mounted on the chassis proximal to the tool engaging end of the adjustable working arm, the ground engaging means further comprising a forward axle carrying wheel means thereon and being mounted on the chassis distal from the tool engaging end of the adjustable working arm wherein the turf undercutting blade is disposed substantially vertically below the axis of rotation of the aft axle.

Ideally, the turf cutting knife comprises a turf undercutting blade buried underground and substantially horizontally orientated in use and a turf side-cutting blade extending upwardly from each lateral edge of the turf undercutting blade, the side cutting knives having mounting means on their free ends for mounting the turf cutting knife onto the tool receiving means of the adjustable working arm whereby in use the side cutting blades are disposed laterally of the ground engaging means.

Ideally, the tool receiving means comprises a crossbar mounted on the tool-engaging end of the adjustable working arm.

Preferably, the crossbar is substantially parallel to the axis of rotation of the ground engaging means.

Ideally, the longitudinal axis of the crossbar is substantially perpendicular to the plane of oscillation of the adjustable working arm.

In another aspect of the invention, there is provided an apparatus for cutting turf, for soil decompaction and for soil drainage comprising a chassis have ground engaging means, an adjustable working arm having a chassis-engaging end movably mounted on the chassis and a tool-engaging end having means for receiving a tool, the apparatus having means for oscillating the tool engaging end of the adjustable working arm wherein a turf cutting knife comprising a turf undercutting blade orientated substantially horizontally in use is mounted on the tool receiving means of the adjustable working arm and the turf undercutting blade is disposed substantially vertically below the axis of rotation of the ground engaging means.

Preferably, the ground engaging means comprises an aft axle carrying wheel means thereon and being mounted on the chassis proximal to the tool engaging end of the adjustable working arm, the ground engaging means further comprising a forward axle carrying wheel means thereon and being mounted on the chassis distal from the tool engaging end of the adjustable working arm wherein the turf undercutting blade is disposed substantially vertically below the axis of rotation of the aft axle.

Ideally, the turf cutting knife comprises a turf undercutting blade buried underground and substantially horizontally orientated in use and a turf side-cutting blade extending upwardly from each lateral edge of the turf undercutting blade, the side cutting knives having mounting means on their free ends for mounting the turf cutting knife onto the tool receiving means of the adjustable working arm whereby in use the side cutting blades are disposed laterally of the ground engaging means.

Ideally, the tool receiving means comprises a crossbar mounted on the tool-engaging end of the adjustable working arm.

Preferably, the crossbar is substantially parallel to the axis of rotation of the ground engaging means.

Ideally, the longitudinal axis of the crossbar is substantially perpendicular to the plane of oscillation of the adjustable working arm.

Preferably, the oscillating means comprises a drive means mounted on the chassis and a single connecting rod mounted intermediate the drive means and the adjustable working arm.

Ideally, the drive means is a camshaft.

Preferably, the connecting rod is movably mounted on the adjustable working arm intermediate its two ends.

Ideally, the chassis-engaging end of the adjustable working arm is pivotally mounted on a housing which is movably mounted on the chassis.

Preferably, the housing is a depth-set housing which is movable along a substantially vertical axis for adjusting the depth of a tool relative to the surface of the ground.

Ideally, the ground engaging means comprises a pair of axles, each axle having a wheel disposed on opposite ends thereof and the chassis, the adjustable working arm and the oscillating means are disposed intermediate the wheels of each axle.

In the case of mole draining and de-compaction when maximum depth is crucial, a single vertical blade preferably centrally mounted on the crossbar is preferred.

The invention will now be described, by way of example only, with reference to the accompanying drawings. In the drawings:-

Fig 1 is a perspective view of a turf cutter with the chassis side cut away to expose the turf cutting knife drive mechanism. A single connecting rod is used instead of the traditional two and a cam-shaft instead of a crank-shaft;

Fig 2 is a side elevation view of a turf cutting knife drive mechanism and drive train illustrating precision of cut;

Figs. 3, 4 & 5 are illustrations of alternative blade positioning and it effect on depth consistency;

Fig. 7 is an elevation view of a cut depth setting mechanism;

Fig. 8 is a rear view of the turf cutting apparatus;

Fig. 9 is a perpective view showing a ground drive clutch engagement activator mechanism;

Fig. 10 is a side elevation view of a fixed speed ground drive mechanism using two stage reduction compound sprockets;

Fig. 11 is a side elevation view of a variable speed forward and reverse ground drive using a self-contained hydrostatic unit;

Fig. 12 is a side elevation view of a sub plough de-compactor in use;

Fig. 13 is a rear view of a sub plough showing central mounting and off-set;

Fig. 14 is an underside plan view of a sub-plough;

Fig. 15 is a perspective view showing interchangeable turf cutter blades illustrating a method of attaching different widths using long and short blade mounting brackets 76 and 13 and extended side knives 9 which position the undercutting blade 10 under the blade wheels;

Fig. 16 is a perspective view of a sub plough blade showing centre mounting bracket 65, cutting edges 66 & 67 plus off-set plough plate section 72;

Fig. 17 is a perspective view of a mole drain blade using the same central mounting system and cutting edges with mole drain bullet 71 attached;

Fig. 18 is a side elevation view of the front transport axle arrangement enabling sufficient ground clearance for deep blades for transporting and manoeuvring the machine. The front transport axle's central location gives it good balance for operation.

Fig 20 is a perspective view of a complete apparatus;

Fig 20A is a rear view of the complete apparatus of Fig 20;

Fig. 21 is a perspective view of how the various width blades and blade wheels are interchanged by removing single accessible bolts.

Referring to the drawings generally, consistency of cut depth has been achieved by positioning the cutter blade bottom knife or turf undercutting blade (10) at an adjustable distance directly below and on the vertical centre line (6) of the rear wheel axle 14. The traditional method of tilting the machine forward in order to raise the cutter clear of the ground requires that the cutter blade follow a sufficient distance behind the rear wheel axle (14). The said cutter blade cannot be lifted clear of the ground when it is positioned directly below blade wheel (5) rear axle (6) so a second wheel axle or front axle (8) is required directly in front of the said rear axle or aft axle. The said second wheel axle is positioned in the centre of the chassis (1) for balance and for ease of handling. Both axles can be driven. The second axle or front wheel axle (8) is used for transporting and turning the machine between cuts and therefore if it is driven should incorporate a clutch mechanism (15) to disengage drive. The clutch should be capable of engaging at any point of rotation such as a disc or cone clutch. The operator activates the clutch by a lever with a direct linkage such as toggle rod (25), see Fig. 9. Drive is transferred from cam shaft (11) to the said front axle either directly or via a compound sprocket or sprockets in order to achieve the correct gearing or ground speed. Alternatively a variable speed drive (Fig. 11) such as an expanding pulley or self contained hydrostatic unit or gearbox could be incorporated. This would give the operator a choice of cutting speeds plus rapid transport and reverse. The drive to the said alternative drive unit would come directly from the power source or engine. This would enable the drive to be disconnected from the blade drive mechanism when in transport mode. The ground engaging blade wheels (5) on the aft axle are as important in the cutting operation as the blades themselves. If they are driven they remain permanently in drive (they do not need to free wheel) because they leave the ground with the blade when raised clear of the ground and out of work.

Turf cutter blades (see Fig. 15) have sides (9) which act as knives to slice the turf to width. In the interests of leaving a clean edge on the cut turf it is essential that the forward cutting edge is angled forward relative to the turf surface to effect a slicing action rather than a torn ragged edge.

With the said bottom blade knife (10) being positioned under the said blade wheels (5) the side knives must be alongside the blade wheels. In the interests of the operator regarding alignment of cut the said side knives (9) should be outside the blade wheels. The blade wheels (5) therefore must be contained inside the confines of the blade side knives (9) and the chassis and drive mechanism must be contained inside the confines of the wheels.

Given that a turf cutter should be capable of cutting a 30cm (12 inch) width, a narrow chassis and drive mechanism is essential. Traditionally turf cutter blades have been driven by a crank shaft incorporating two connecting rods. In order to function within the said constraints, the mechanism has been designed with only one connecting rod. It is driven with a cam-shaft rather than a crank and the said cam-shaft (11) and drive mechanism is contained within the narrow chassis (1) and enclosed to protect it from soil and debris thrown from the cutter blade. The said single connecting rod (2) imparts a forward and backward horizontal stroke to the cutter blade via an adjustable working arm comprising a double leg structure (3) which is pivotally connected to the depth set housing at its uppermost end. The said double leg structure extends through two narrow slots (16), see Fig. 8 and Fig. 21 to the rear of the said narrow chassis and attaches to a cross member or crossbar (4). The said cross member (4) has mounting points for various blade arrangements, its rearward position makes it accessible by the operator to change blades. The said uppermost pivotal connection (17) of the double leg structure (3) has a mechanism to adjust the said pivotal connection along a vertical axis (18) in order to adjust the depth or thickness of cut. The said vertical axis maintains the position of the said cutting blade bottom knife (10) on the said vertical centre line (6) of the rear axle (6) of blade wheel (5) throughout the full range of depth adjustment along the vertical axis.

Referring especially to Fig. 7, the said depth adjustment mechanism consists of depth-set housing (27) one end of which contains the said uppermost pivotal connection (17). The other end of the said housing consists of a hollow cross member (201) through which depth clamp-bolt (28) passes. The said depth clamp bolt extends through a depth adjustment slot (29) which cuts through both sides of the said chassis (1). The said depth clamp bolt (28) also passes through a similar slot (29) which is cut through a free end of a depth clamp plate (30).The other end of the said depth clamp plate (30) is rigidly bolted to the said chassis (1) with spacer plate (31) sandwiched between to maintain a gap between the said depth clamp plate and the said chassis. The slotted portion of the depth clamp plate (30) is thereby free to clamp and release by flexing as the said depth camp bolt (28) is tightened and released by a threaded clamp lever (32). A depth adjustment spindle (34) extends through a hole in the upper face of the said chassis (1) in a manner which allows the said

spindle (34) to rotate while being captivated and restricted in linear or vertical movement. Depth-set hand wheel (35) is attached to the upper end of the said depth adjustment spindle (34). The lower portion of the said spindle (34) is threaded and extends downward through a threaded hole in the central portion of the said depth set housing (27). When the said depth clamp lever (32) is released the said depth set housing (27) can be raised and lowered along the path of the said slots (29) by turning the said depth set hand-wheel (35). Depth pointer (33) is fixedly attached to the head of the said depth clamp bolt (28). The said depth clamp bolt head is square or rectangular shaped to fit between guide rails (36) which form part of the said depth clamp plate (30) and thereby preventing the bolt head from rotating. A depth scale 222 can be fixedly attached to or inscribed into the outer face of the said depth clamp plate (30). The said depth pointer washer coinciding with the said depth scale accurately indicates the depth of cut or thickness of turf. After the desired depth is selected by turning the said depth-set hand wheel (35), the depth-set housing (27) is locked in position by tightening the said threaded clamp lever (32). The said hollow cross member (201) of the depth set housing (27) is firmly clamped between the said flexible depth clamp plate (30) and the rigid side of the said chassis (1). The said depth set housing (27) can thereby withstand the thrusting action of the said cutter blades (9, 10) which are attached to the opposite and lower end of the said double leg structure (3) without slipping or coming loose.

By way of example the power is transmitted to the said blade drive mechanism as illustrated in Fig 2. The engine power source (12) transfers drive through engine clutch (19) which may have centrifugal engagement to lay shaft (20) via v-belt (21). Lay-shaft sprocket (22) transfers the drive via cam drive-chain (23) to cam-shaft sprocket (24).

Referring especially to Fig. 15, a range of turf cutting blades (9, 10) are available for the machine from 12 inch to 18 inch or any width between e.g. 12, 14, 16, and 18 inch. These are bolted to the extreme right and left mounting points on the said blade mounting cross member or crossbar (4). The said blade wheels (5) are also available in widths which correspond with the blades (9, 10). These are interchangeable and although a 12 inch blade wheel (5) could be used with a wider blade, lateral precision of cut and stability would suffer. In the interests of maintaining lateral precision of depth (turf thickness) blade wheels (5) which correspond to the blade width must be used. The said blade mounting cross-member (4) is positioned a sufficient distance behind the blade wheels (5) to allow it to oscillate. A mounting bracket 13, 76 is fashioned to bolt to the said cross-member (4) and extends out and is rigidly attached to the said blade side knives (9). The said mounting bracket varies in length according to the blade width. The blade side knives (9) extend forward in a vertical plane sufficiently as to place the cutting edge of the horizontal portion of the cutting blade of the

bottom knife (10) under the blade wheel (5) on the said vertical axle centre line (6), see Fig. 1. The said blade side knives (9) continue forward of the said horizontal portion of the blade (10) in an upward sweep to effect a slicing action through the grass roots and soil giving a precision cut edge to the turf.

Referring now to Figs. 16 and 17, the de-compacting and mole drain blades are fashioned in the same manner as the said cutter blade side knives (9). A singular blade (205) is fixedly attached to centre mounting bracket (65) at its top most edge. The said mounting bracket (65) bolts to the centre mounting holes (64), see Fig. 21 on the said blade mounting cross member (4) of the drive mechanism. The front or foremost edge of the said single blade (205) extends forward and forms a v-shape. The said vee is the cutting edge of the blade (205) the upper v-portion (66) slicing through the grass roots in the same manner as the said cutter blade side knife (9). The lower v-portion (67) extends forward and down-wards ending in a point. The said lower portion cuts through the soil under the surface, its downward angle helps to pull the blade (205) into the ground for maximum depth in compacted soil. The lower edge (73) of the blade extends backward and slightly upward from the said point. To improve wear and tear the said point of the blade (205) could have a chisel tip (68) on a horizontal plane to the same width or wider than the blade thickness. The rearward edge (72) of the said sub-plough blade (205) extends downwards forming a corner where it meets the said lower edge (73). This corner can have an angular bend on bend axis (74) which runs from about half way along the said lower edge (73) angling backward to join the said rearward edge (72) at a point just below the turf grass surface when in work. The said angled bend projects the rear lower portion of the said singular blade (205) sideways and upwards and thereby acts as a plough. The said plough would effect only the soil under the grass surface shifting it side ways and upwards on the said blade thrusts forward. The said rearward bottom corner would effect a chopping action on the rearward stroke. The said shifting and chop action would be effective in relieving the problem of compaction, improve drainage and stimulate root growth.

Referring now to Fig. 17, in the case of the mole drain blade (69) the said point would have bullet (71) attached to create a circular drain under the turf surface.

The said mole and de-compaction blades can be mounted singularly or in multiples driven by a suitable mechanism as to impart the said back and forward oscillating motion in unison or in a manner out of phase. In a further arrangement the said blades could be multiply mounted in banks at suitable spacing. The said banks could be in multiples and driven in the said oscillating motion in a manor out of phase to reduce the traction requirements and vibration levels. When grouping the said sub plough de-compactor blades in multiples as described they could be positioned a suitable

distance apart and behind each other as with the common multiple furrowed agricultural plough to enable the furrow or soil to move side ways as already described. The said multiple groupings of the said blades and oscillating drive mechanism could be incorporated into a frame for tractor mounting and driven with a power take off shaft. In another arrangement the said blades could be rigidly fixed to a frame in the manner already described for group mounting and propelled by a suitable vehicle such as a four wheel drive tractor which would have sufficient traction as to propel it through the ground without the need for oscillations. These multiple groupings would be suitable for use in larger areas such as football pitches, golf fairways or on grass lands.

Variations and modifications can be made without departing form the scope of the invention described above.

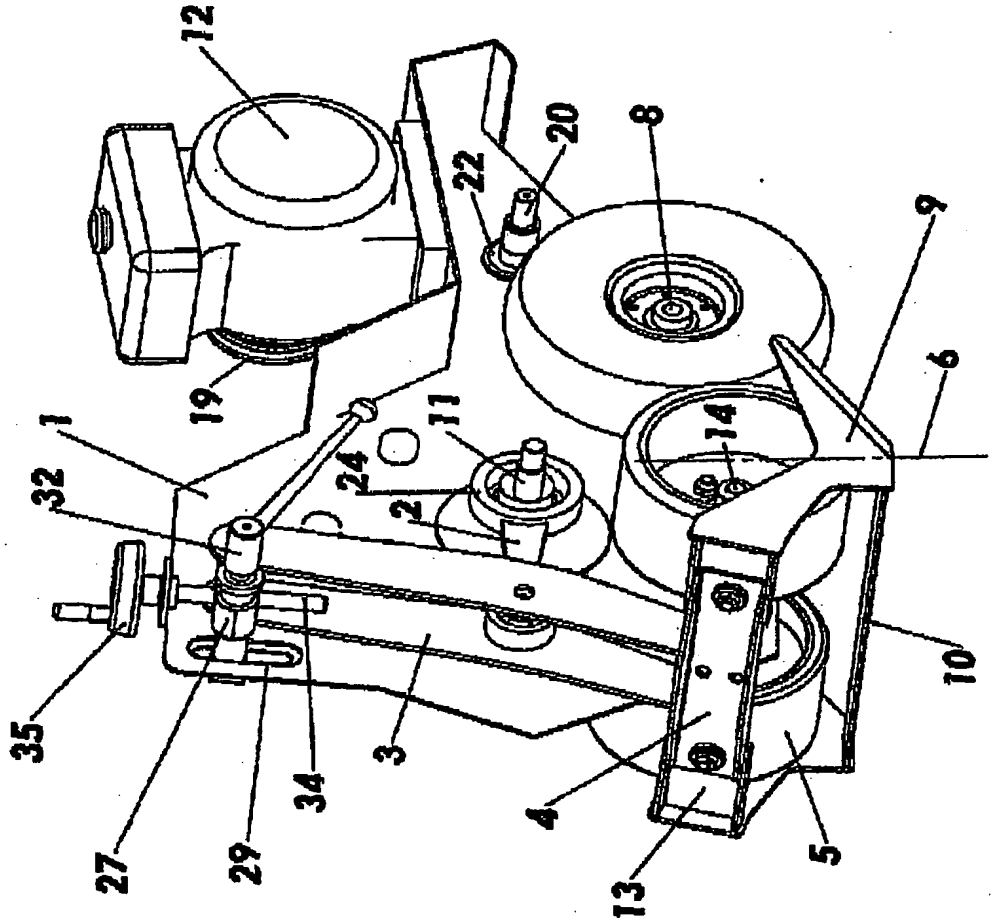


Fig 1

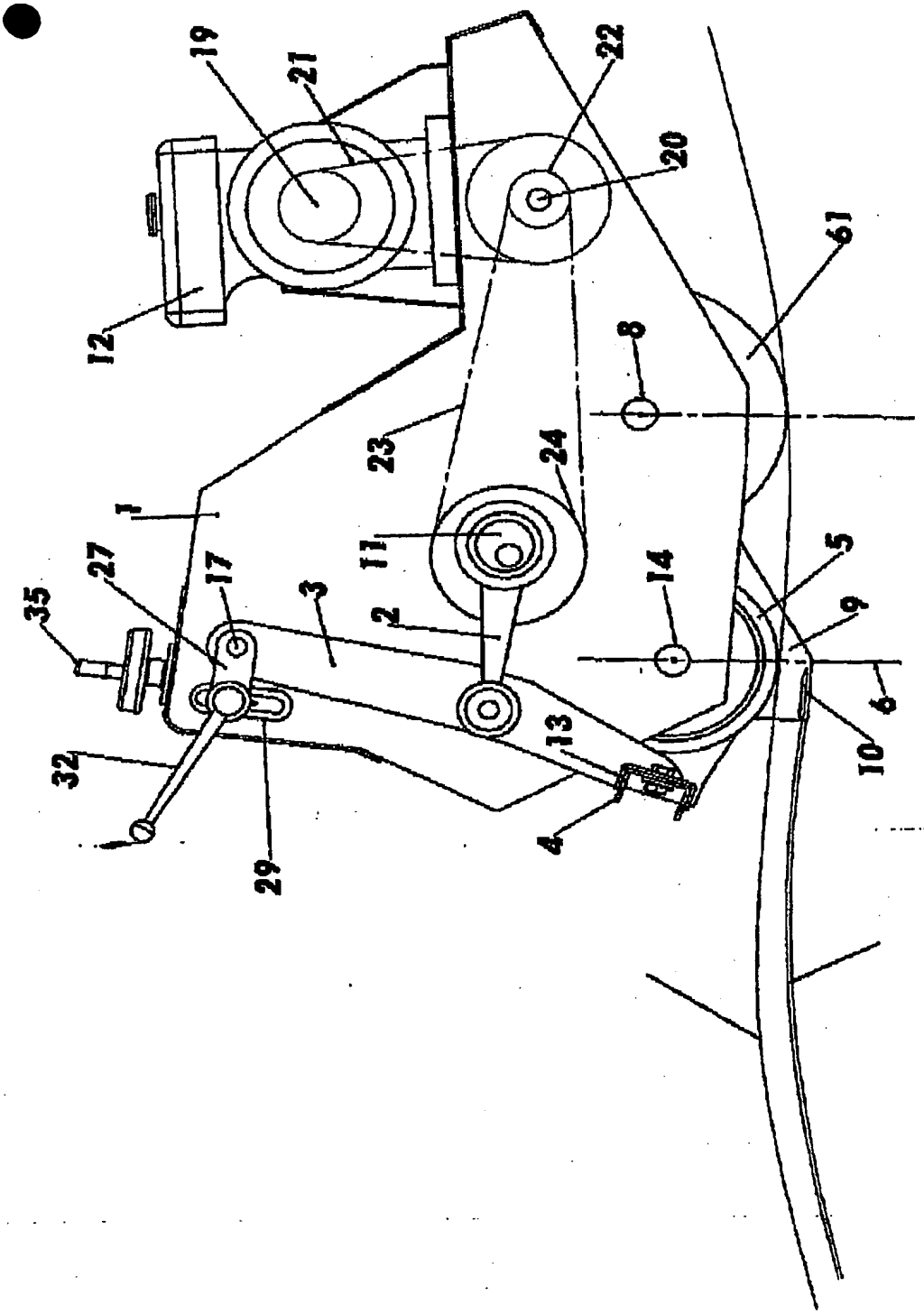


Fig 2

Illustration of Cutter-Blade positioned in front of Wheel-Axle

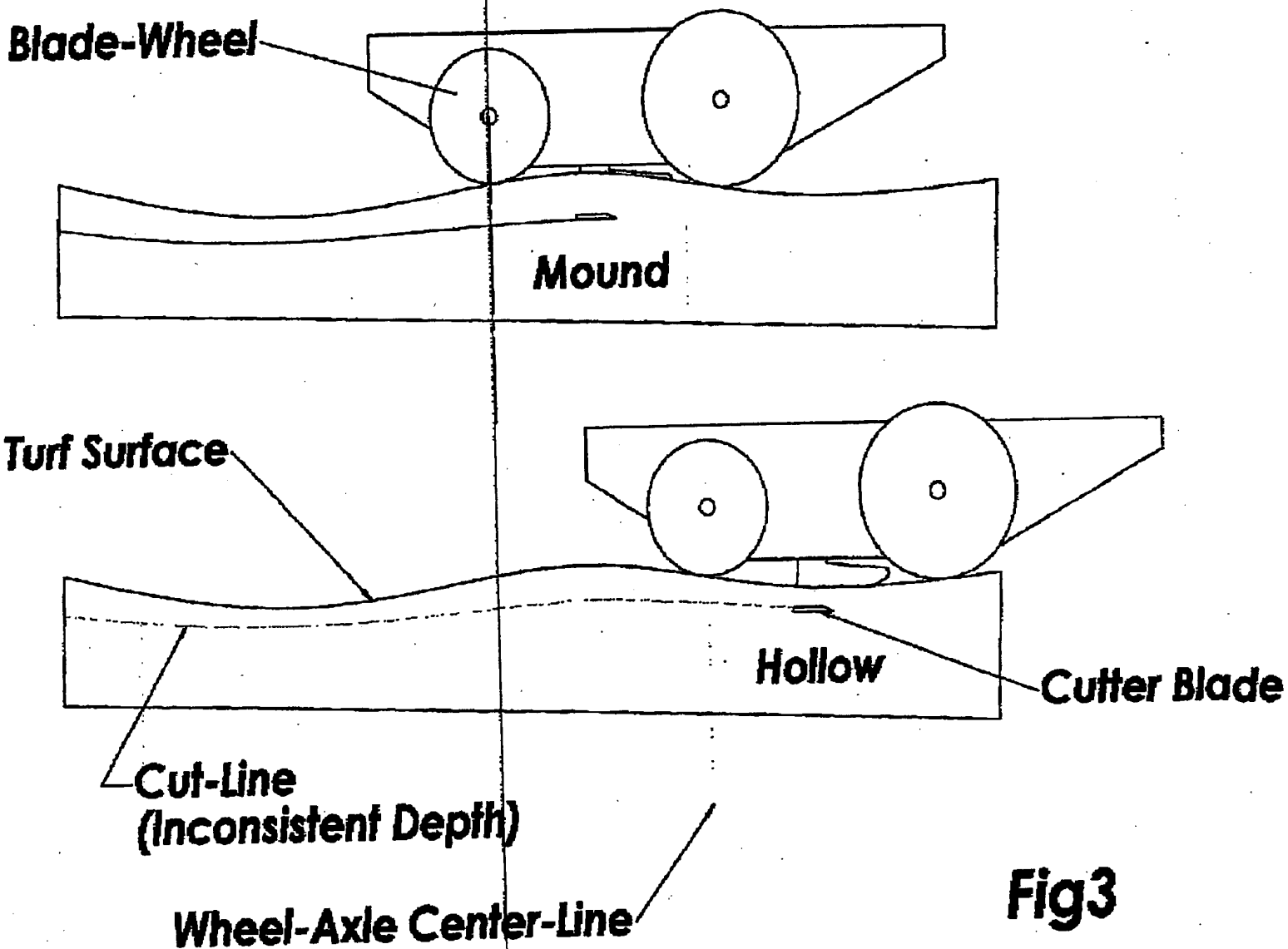


Fig3

Illustration of Cutter-Blade positioned below Wheel-Axle

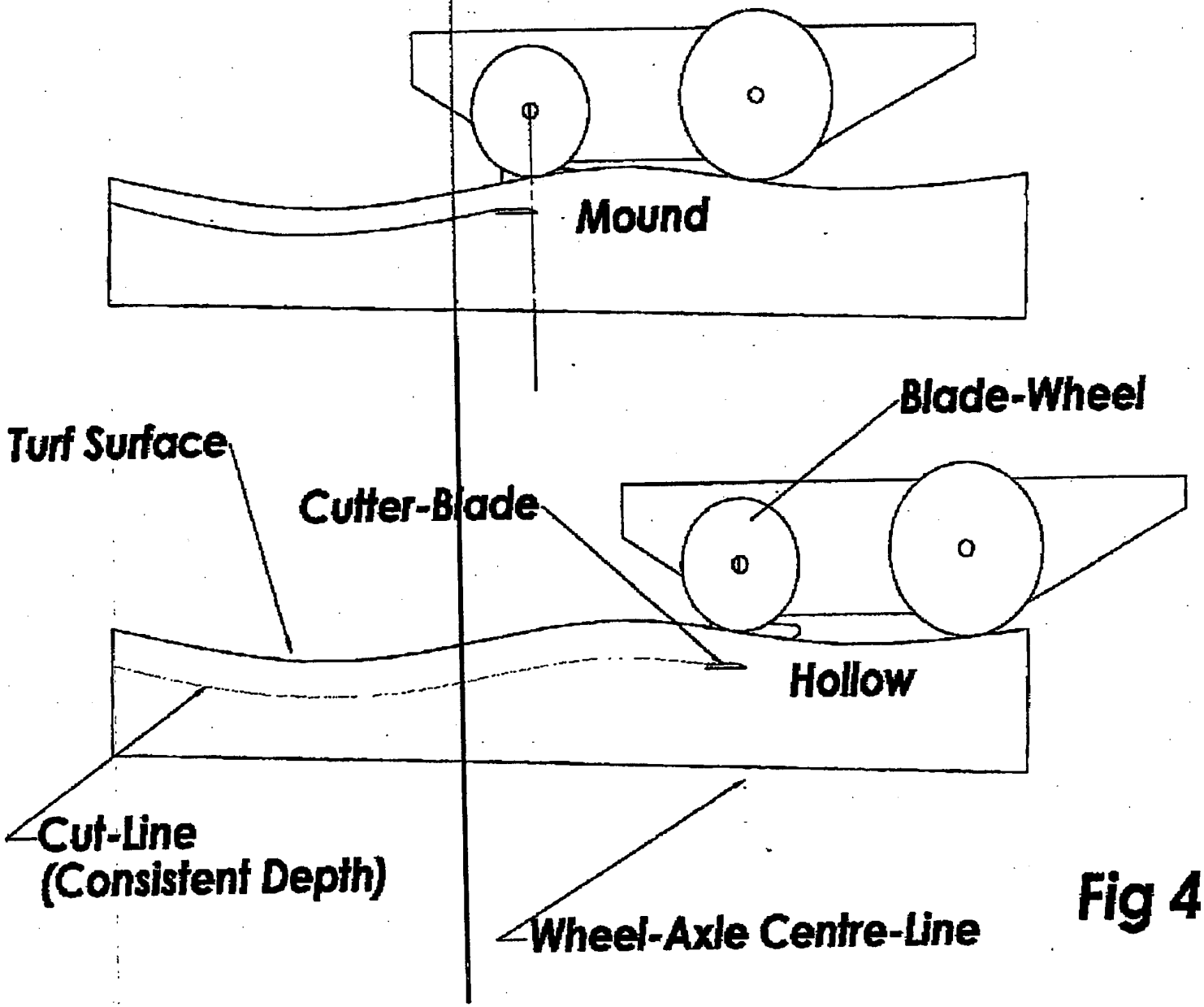


Fig 4

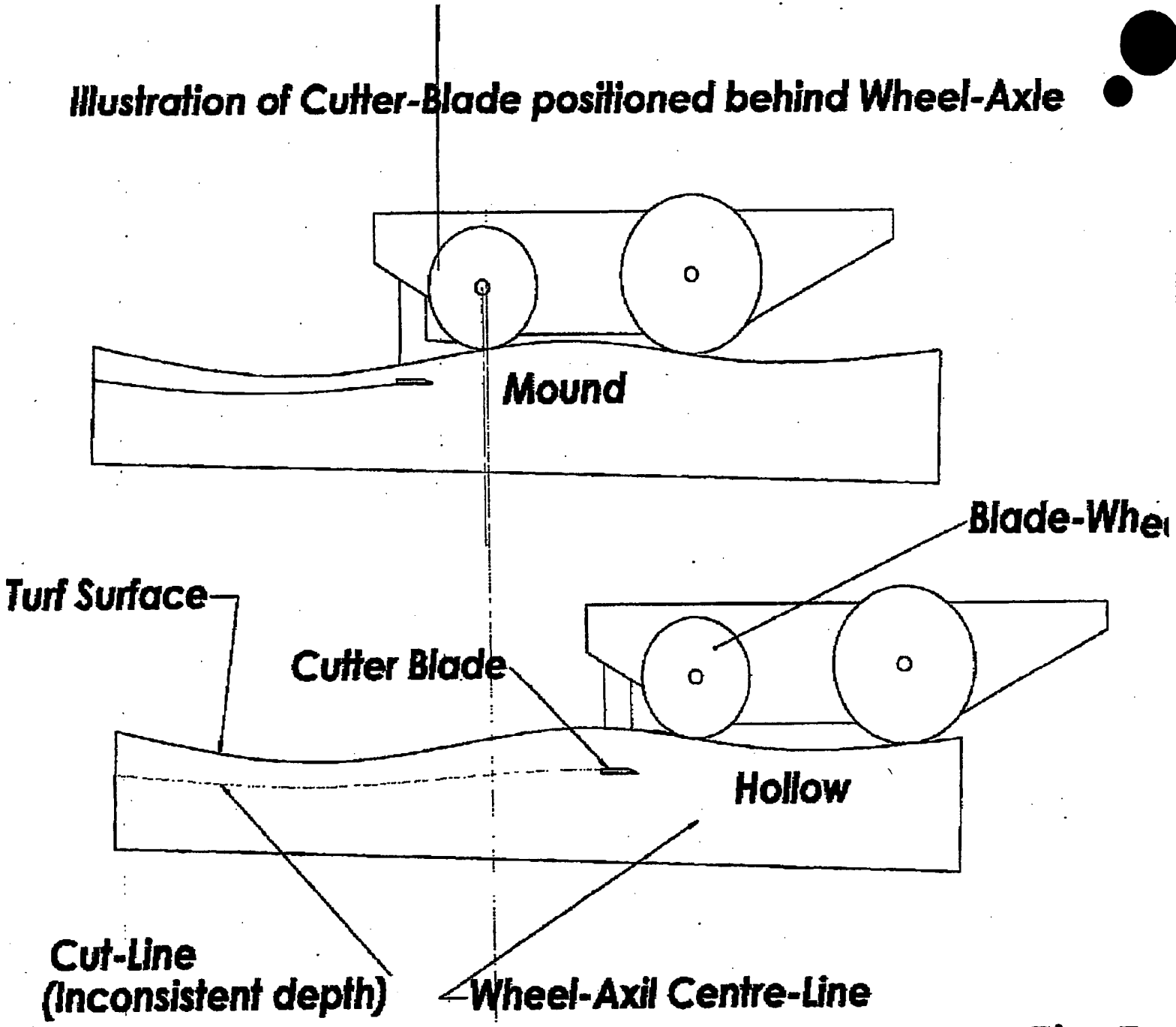


Fig 5

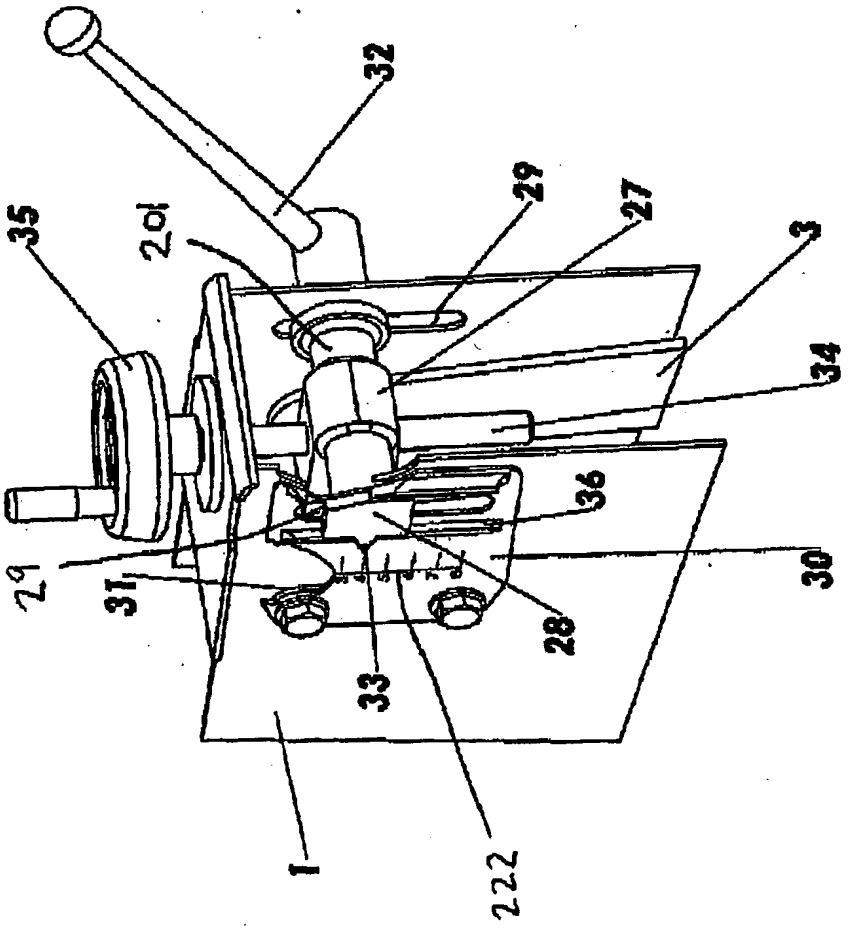
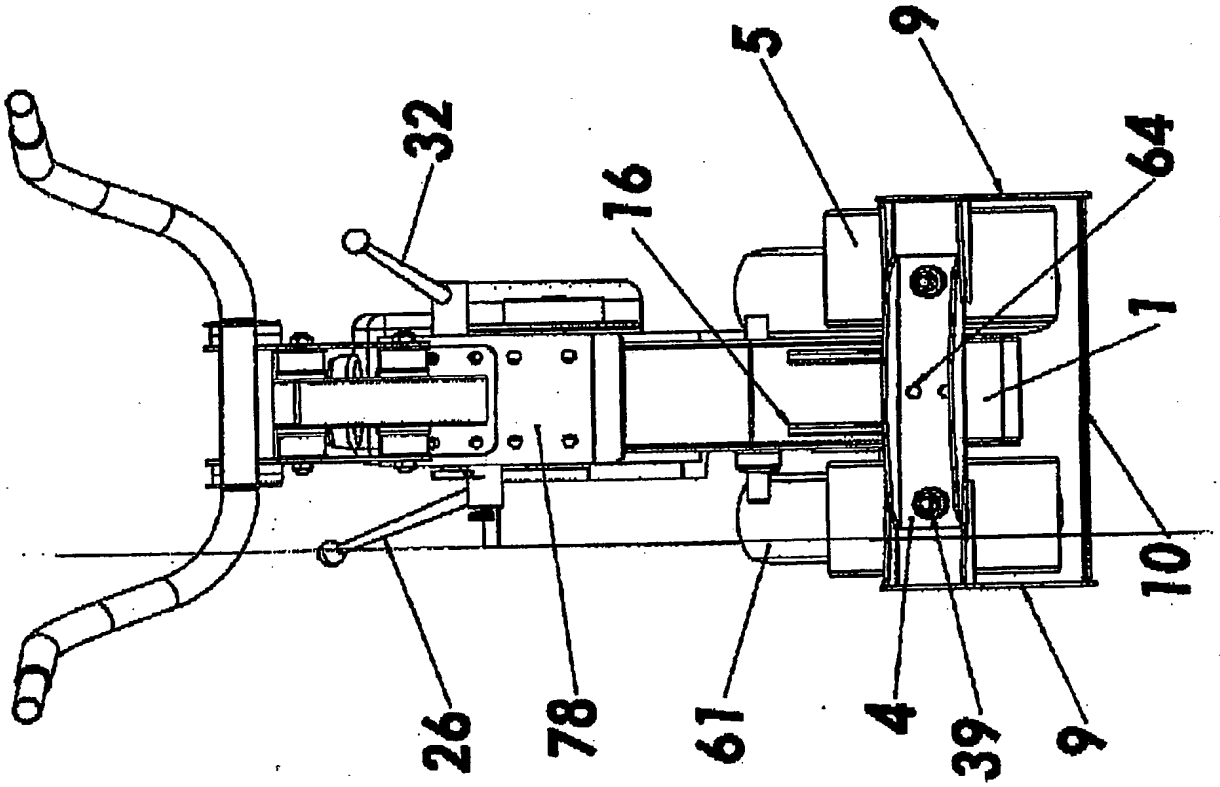


Fig 7

Fig 8



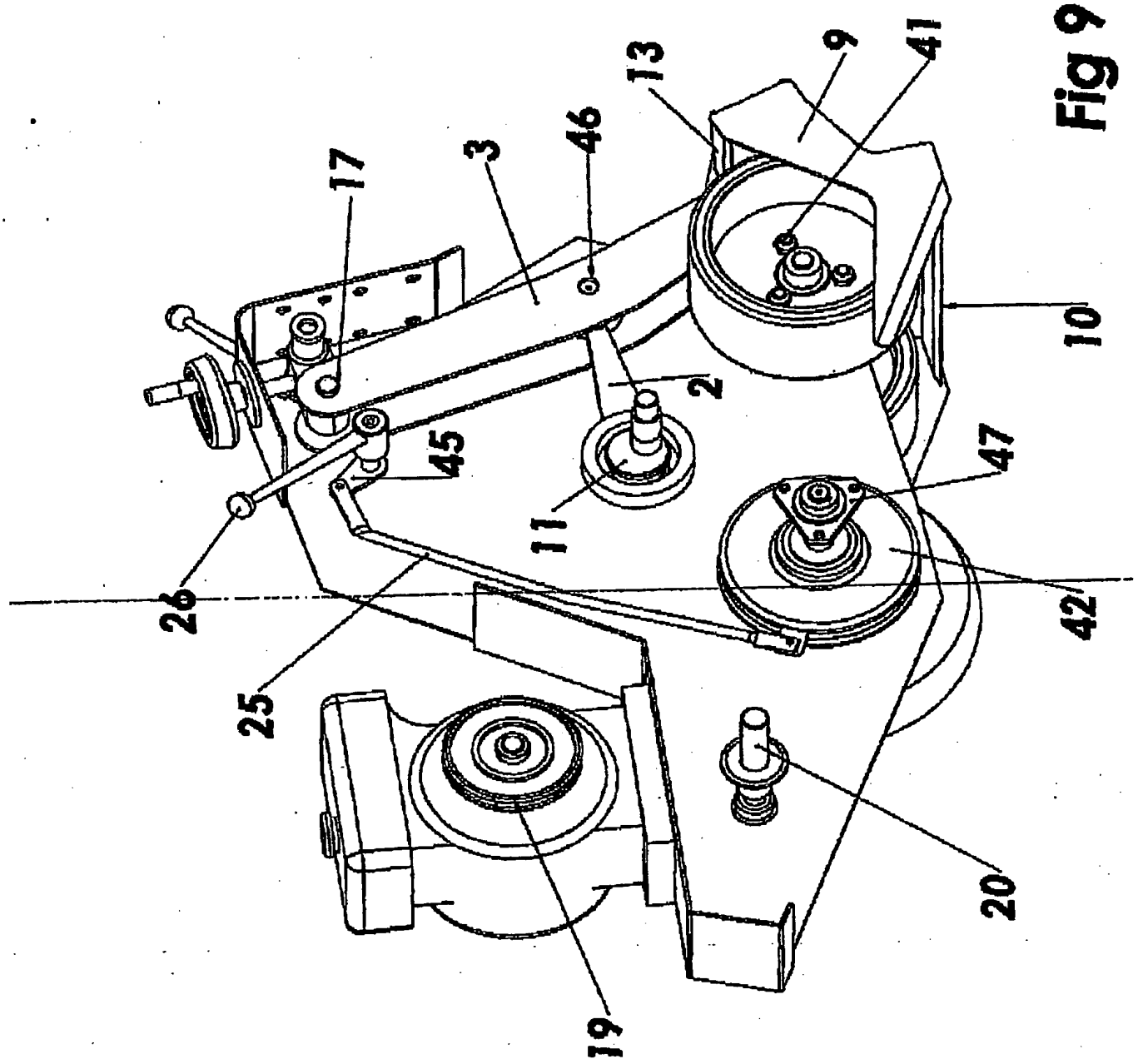


Fig 9

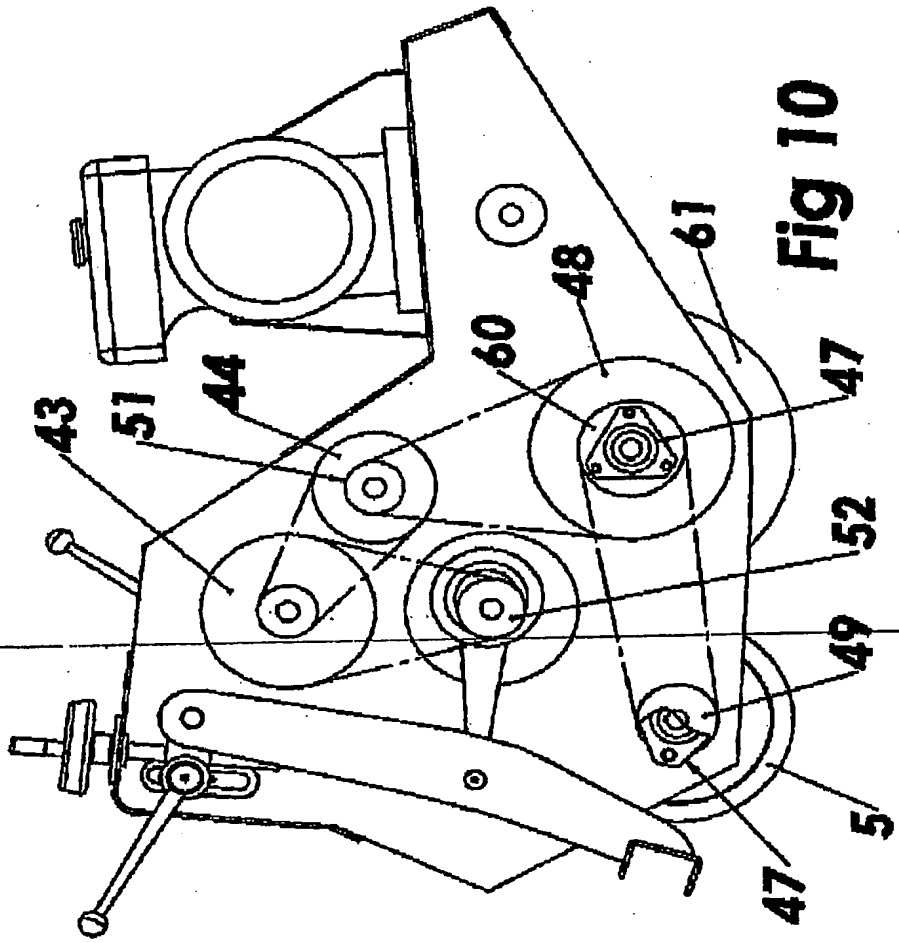


Fig 10

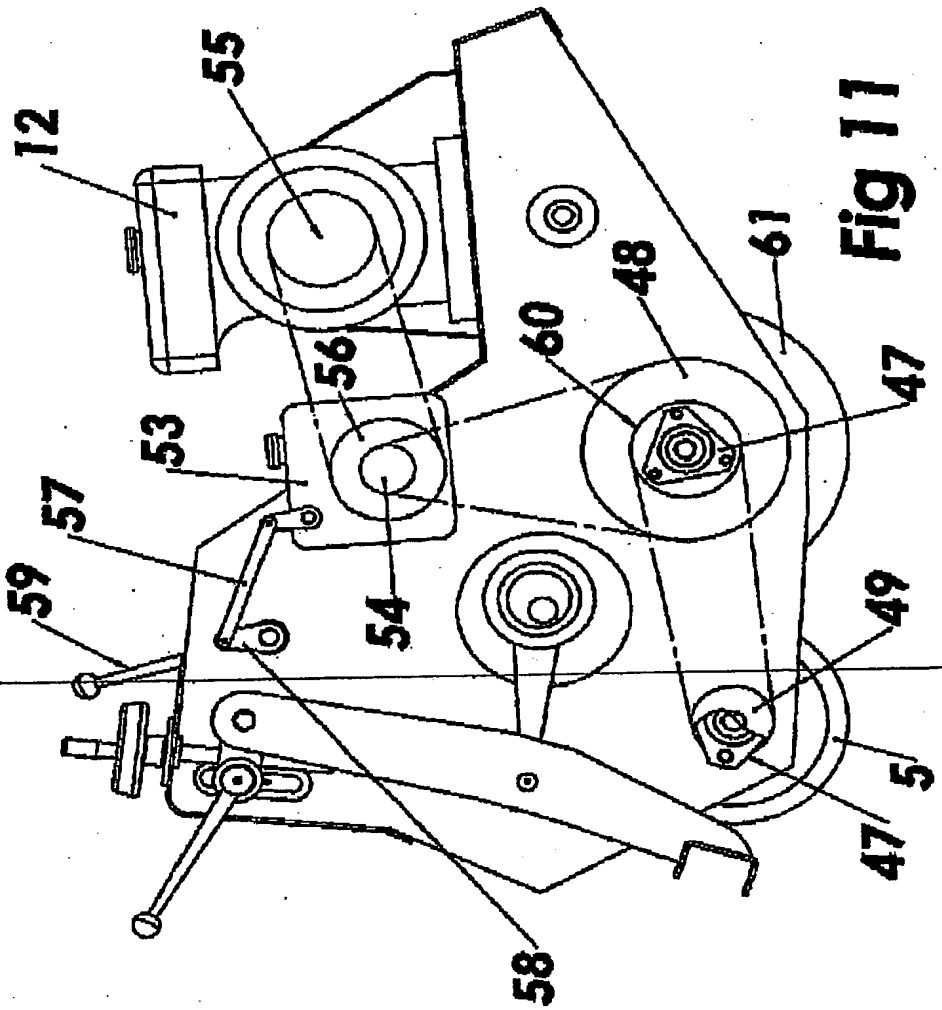


Fig 11

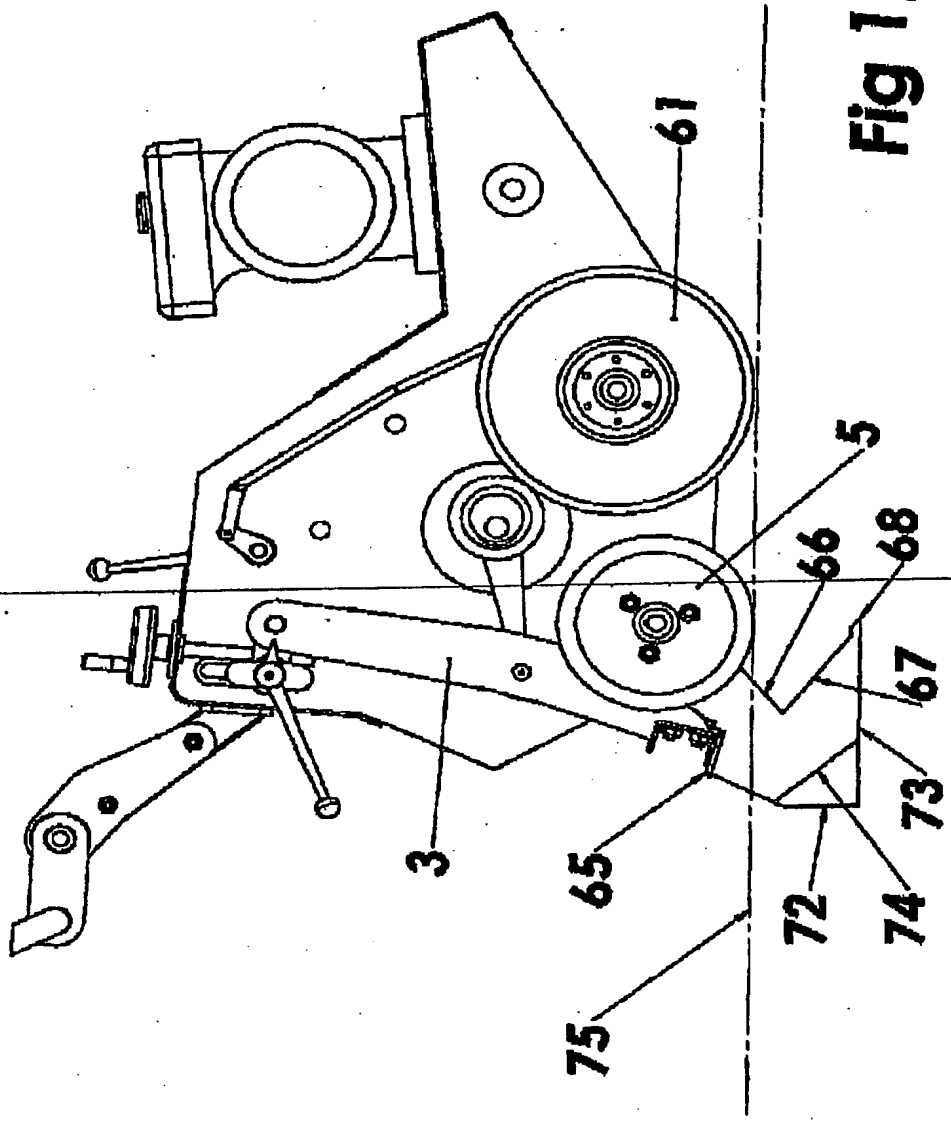


Fig 12

Fig 13

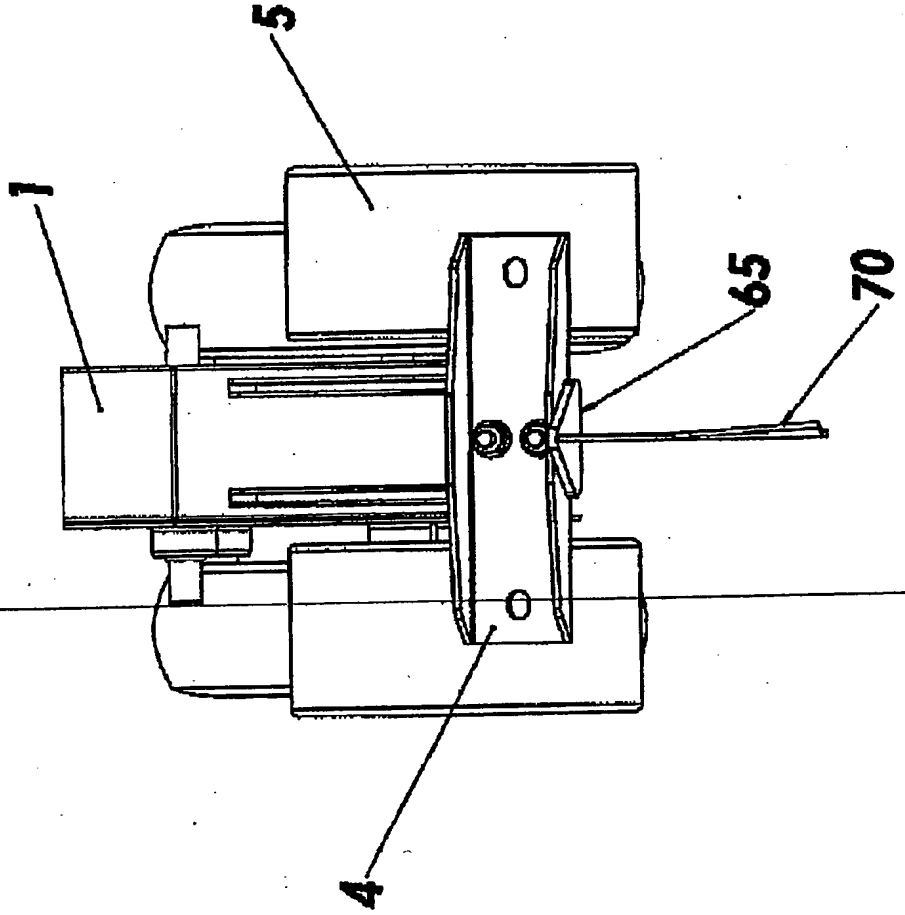


Fig 14

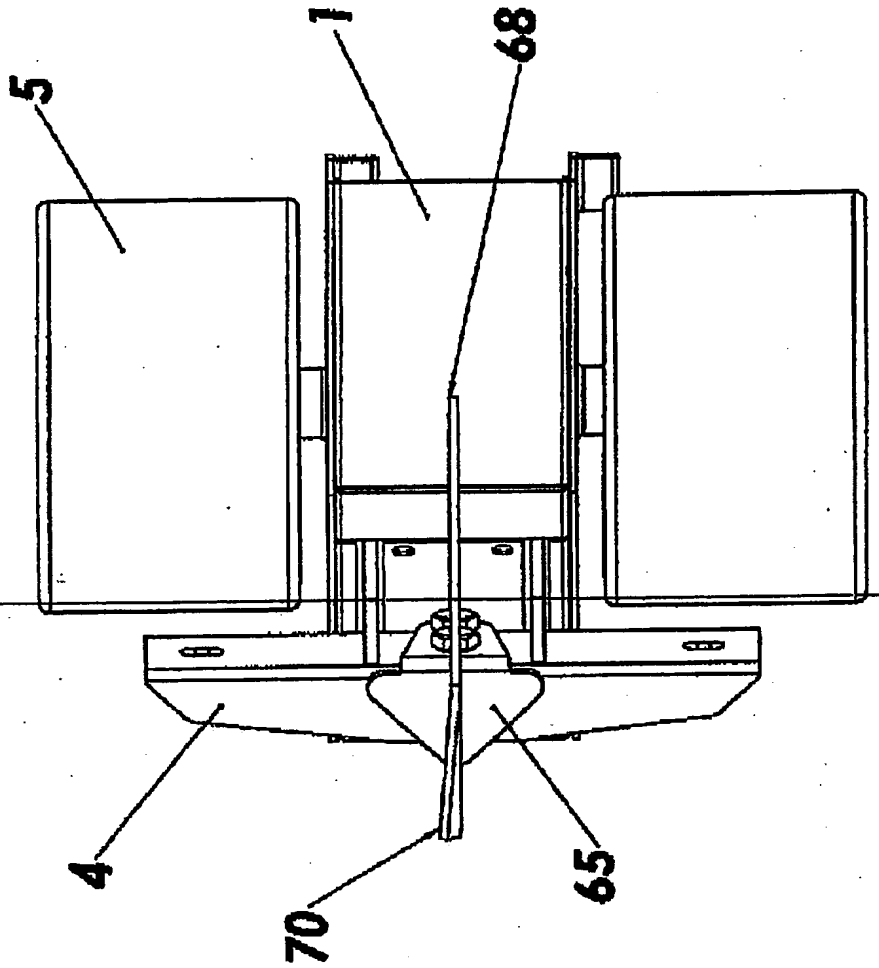
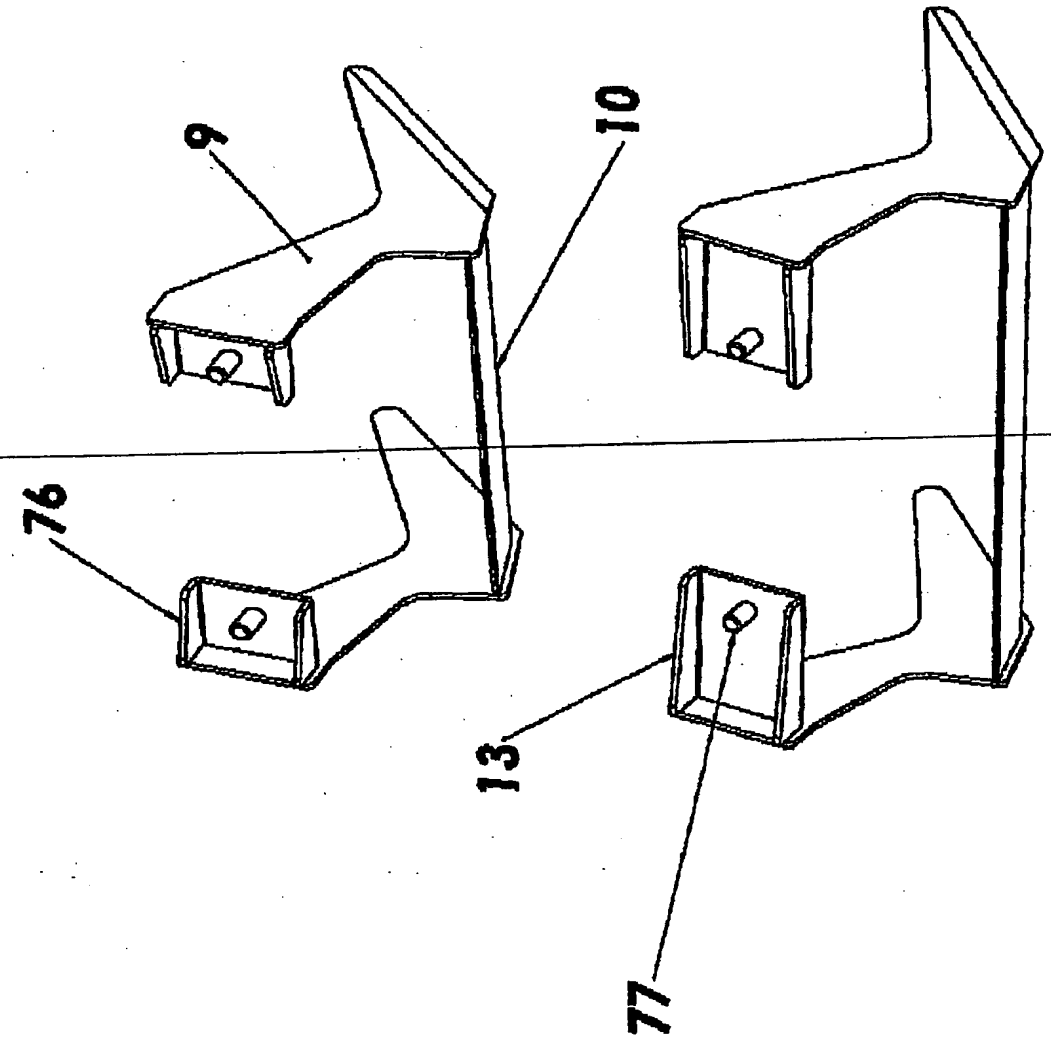


Fig15



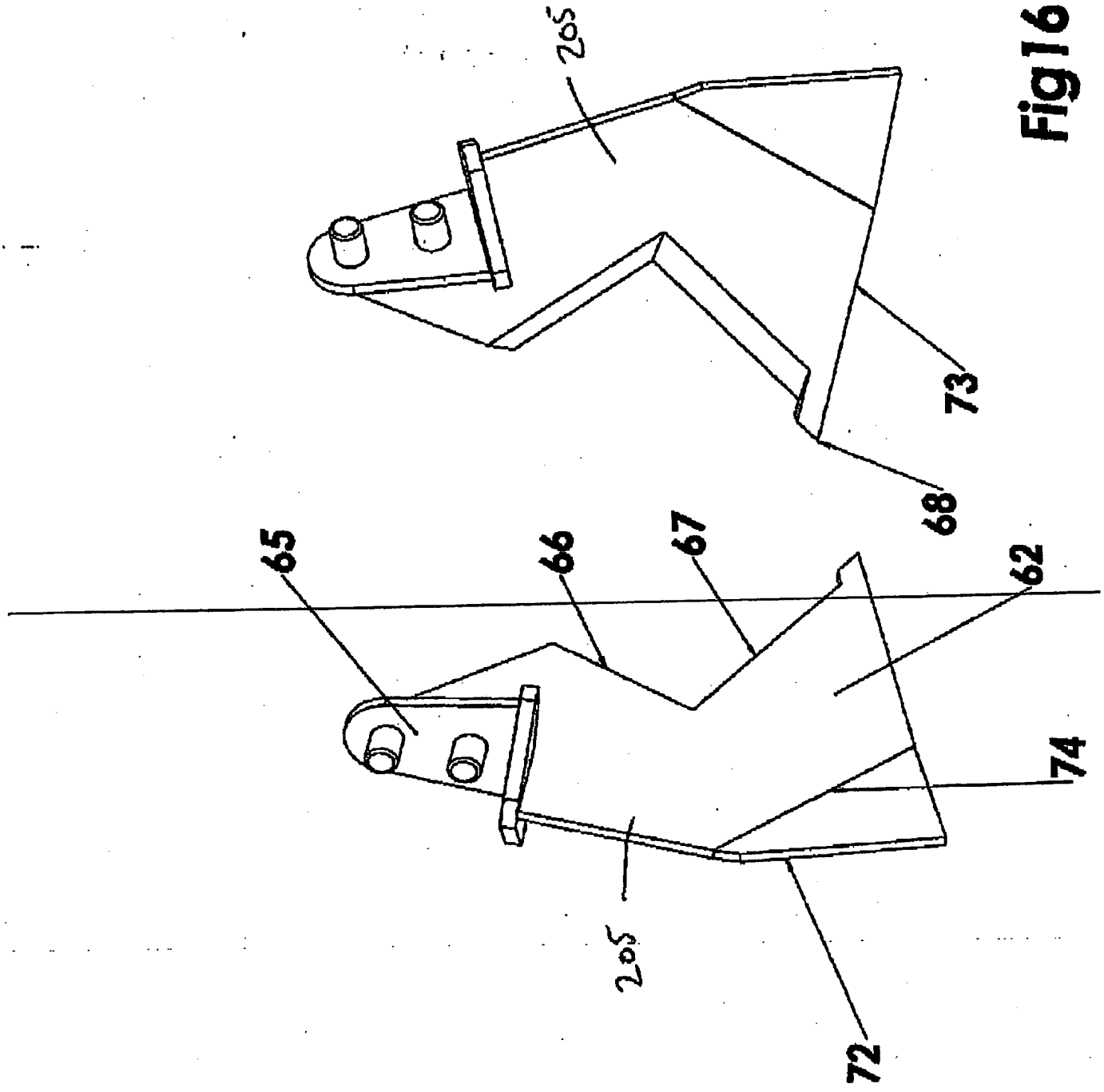


Fig16

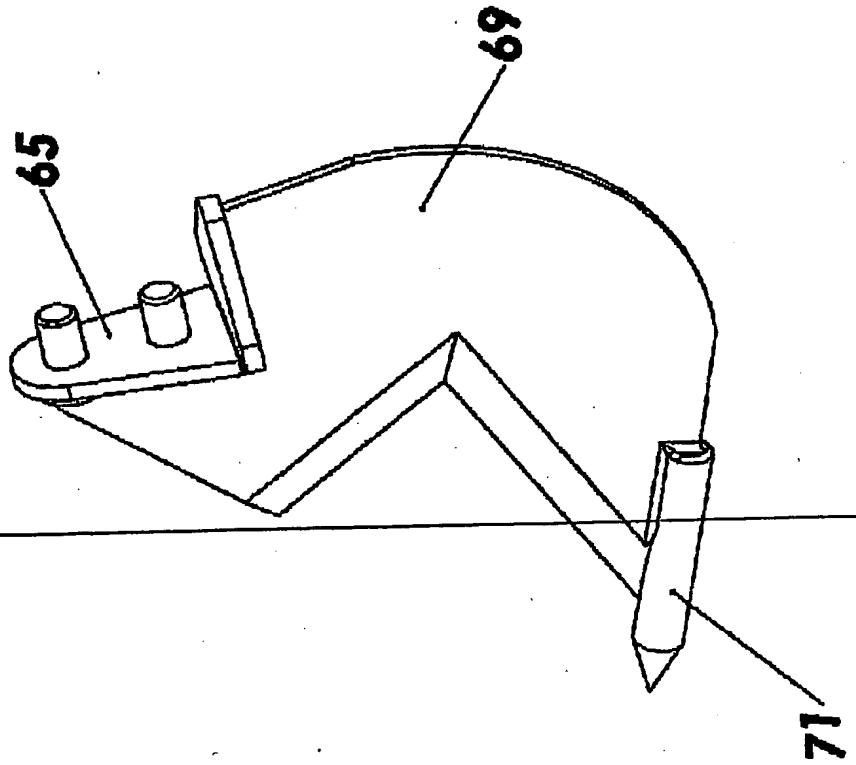


Fig 17

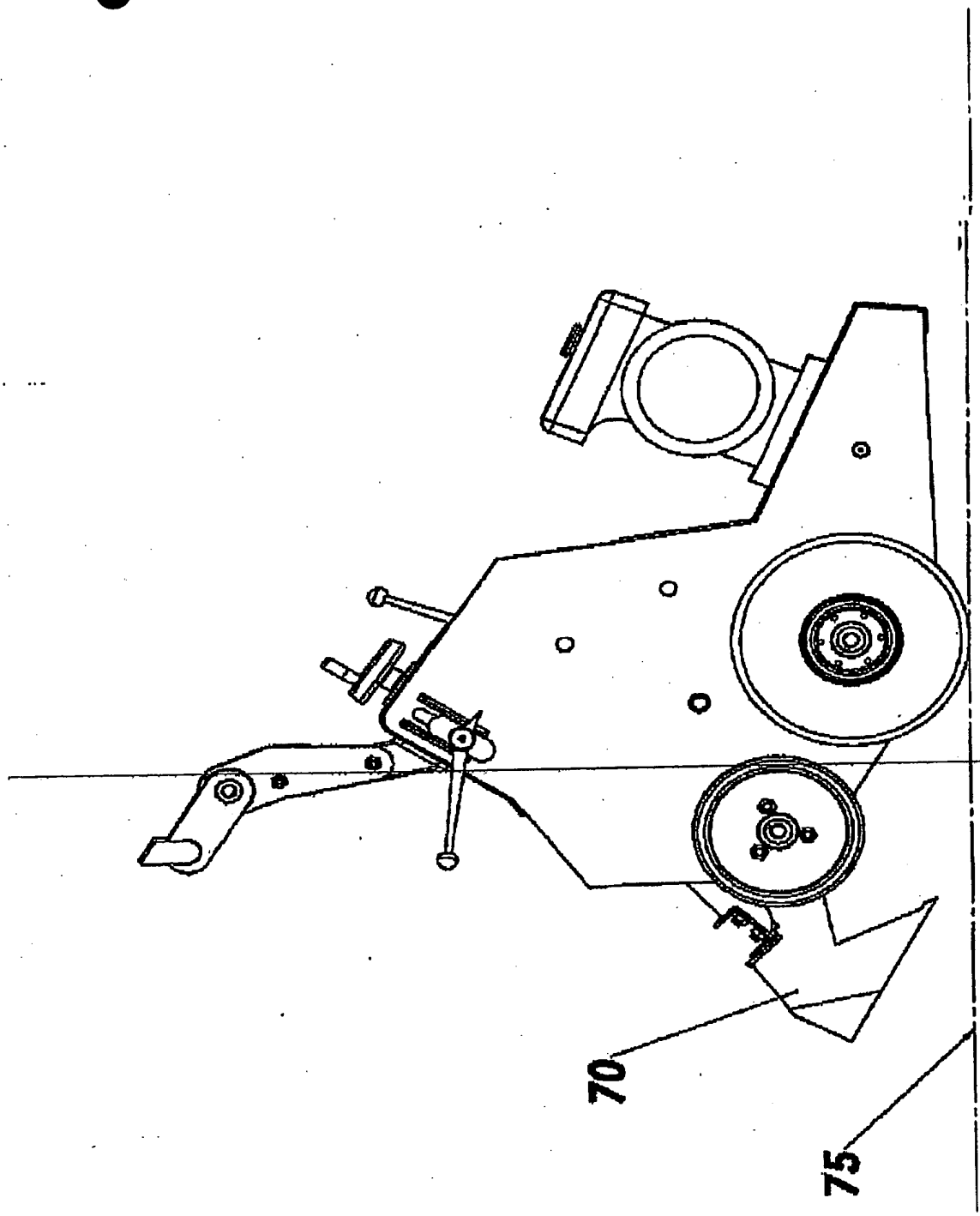


Fig 18

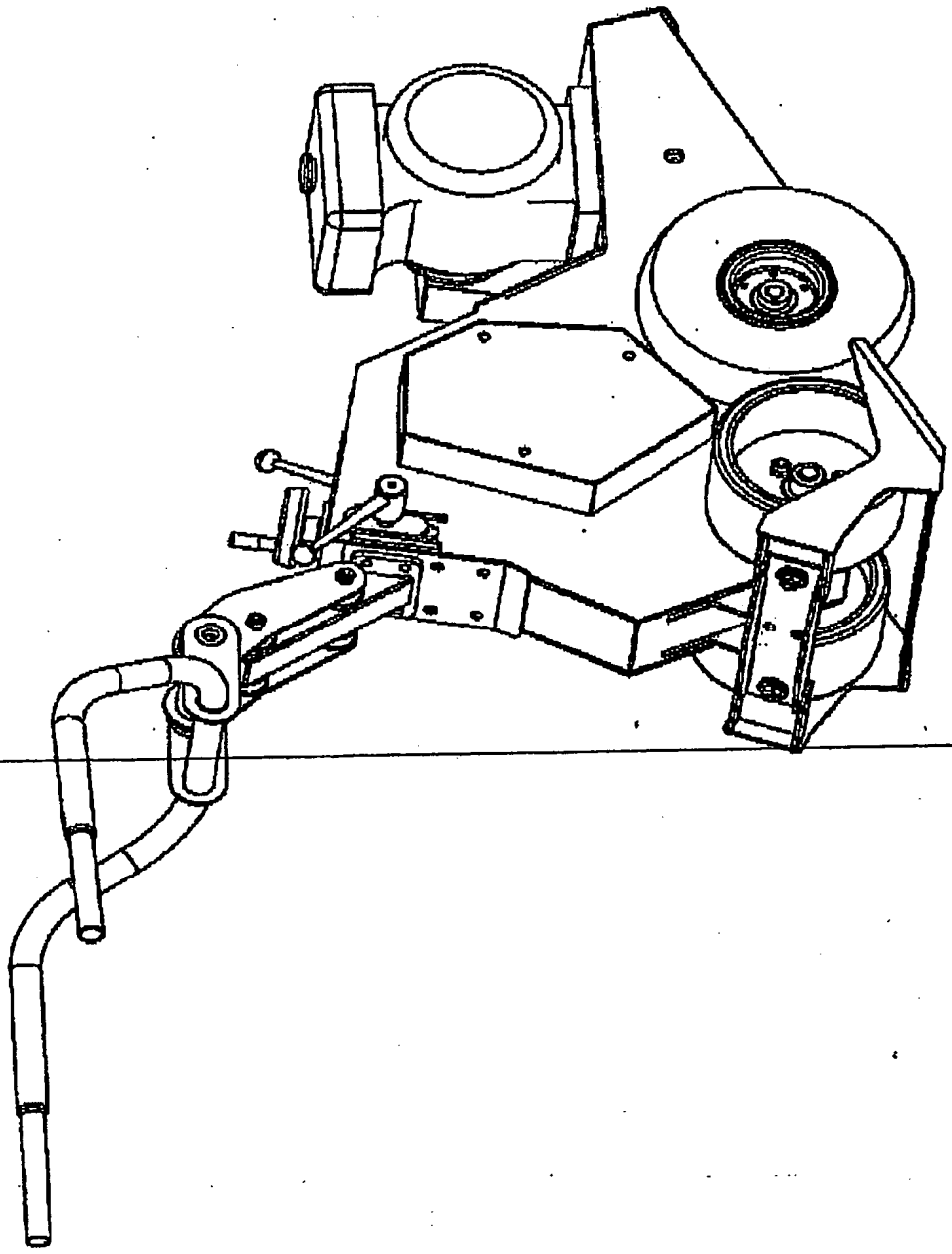


Fig 20

Fig 20A

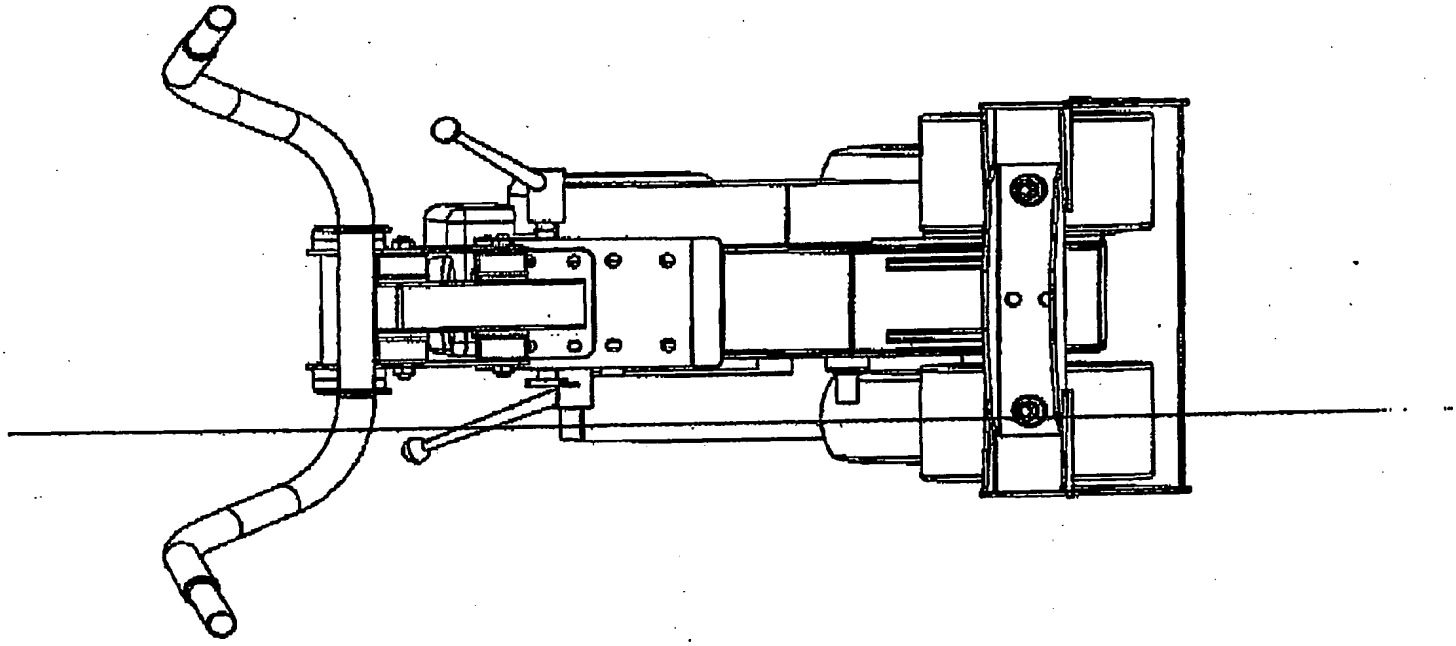


Fig 21